Geriatric surgery is about disease, not age

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Summary

Maintaining life span and quality of life remains a valid aim of surgery in elderly people. Surgery can be an effective way of restoring both length and quality of life to older people. Minimally invasive techniques and surgery under local anaesthesia make fewer demands on geriatric physiology; given that co-morbidity is a stronger predictor of outcome from surgery than age, this is a significant consideration.

In the UK, elderly people are the fastest growing sector of society, and only when a man reaches 86 or a woman 89 is their life expectancy less than 5 years (Figure 1).[1] Despite the substantial life expectancy of older cohorts, doctors sometimes make decisions about diagnostic testing and treatment based purely on age. Over-cautious attitudes towards older people affect all levels of health care, from general practice through to secondary care physicians and surgeons.[2,3]

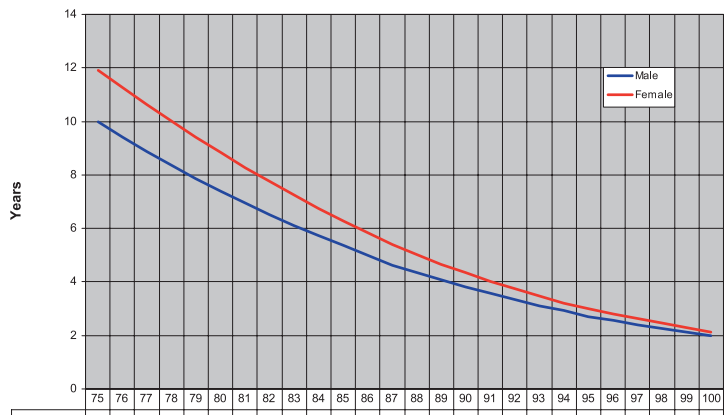
The recent successful repair of an aortic dissection on Dr Michael DeBakey, the 97-year-old pioneer cardiac surgeon, is an example of how the definition of 'too old' continues to change.[4] We have a duty to preserve lifespan, in addition to maintaining the quality of a patient's later years. This principle is echoed in the first standard of the National Service Framework for Older People, which states that 'NHS services will be provided, regardless of age, on the basis of clinical need alone'.[2] Technical advances, such as minimal access surgery and improvements in anaesthetic techniques, have lowered the physiological insult of an operation, thus extending the scope of treatments available to our oldest patients, including our own recent experience of a staged bilateral carotid endarterectomy under local anaesthetic on a 93-year-old man. In this paper, we discuss the evidence base for surgery in elderly people, relevant physiological changes with age, and how the risks of surgery may be minimized in this group. Where possible, data for over-75s are used.

Elective surgery

Elderly people have been largely excluded from high quality trials, and much of the evidence comes from case series of selected patients, which demonstrate what is *possible*. Major elective cardiac, vascular, oncological and orthopaedic surgery can be performed on patients over 75 years old with good outcomes and adverse event rates similar to younger patients.

Coronary artery bypass grafting (CABG) is increasingly performed on patients over 75. The success of percutaneous intervention means that those undergoing open cardiac surgery have more advanced cardiac disease than in the past. Despite this, CABG mortality is falling. For elective surgery, mortality is less than 5%, more than 90% are discharged directly home, and approximately 95% are angina free at 2 years. Mean performance status improves from 'hospitalized with active support' to 'self-caring at home'. The early benefits of CABG are maintained even in the over-90s, although long-term mortality is understandably higher. Some studies have found that natural lifespan encroaches upon 5-year survival from

Figure 1
Life expectancy by age 2003–2005[1]



	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Male	10	9.4	8.9	8.4	7.9	7.4	7	6.5	6.1	5.7	5.4	5	4.6	4.3	4.1	3.8	3.6	3.3	3.1	2.9	2.7	2.6	2.4	2.3	2.1	2
Female	12	11	11	10	9.4	8.8	8.3	7.8	7.2	6.8	6.3	5.8	5.4	5	4.7	4.3	4	3.7	3.5	3.2	3	2.8	2.6	2.5	2.3	2.1

CABG, so that mortality patterns are essentially the same as for the rest of the aged population. The benefits of CABG may go even further, with surgical survivors having longer life expectancy than controls.[5]

Cerebrovascular disease is underinvestigated and undertreated in those over 80 years old.[6] Systematic review has demonstrated that the risk of death (but not non-fatal stroke) due to carotid endarterectomy increases with age, but this is far outweighed by the absolute benefit, which increases more steeply with age due to higher stroke risk without surgery. Indeed, the contribution of age to operative mortality is less than that of gender – the risks for people over 75 are lower than those for women as a group. Should women be refused surgery because of increased operative risk?[7] Even relatively unfit patients can be operated upon under local anaesthetic.[8]

Colorectal cancer is the most common malignancy in people over 65, and surgery is performed to both cure the disease and avoid late complications. If surgery is undertaken with curative intent, cancer-specific survival is the same as for younger patients. As with many types of abdominal surgery, there is a small increase in perioperative mortality and morbidity in elderly people, but once this has passed, long-term outcomes match those of younger patients.[9] Laparoscopic colonic resection shows promise in accelerating recovery in patients over 75.[10]

Minimally invasive thoracotomy for benign disease has a mortality of 2–5% in elderly people, and resection of early lung cancer produces the same prognosis in the elderly and the young.[11] Thyroidectomy and parathyroidectomy carry no excess mortality or morbidity in the elderly compared to younger people, despite older patients having more severe endocrine derangement. The cure rate for hyperparathyroidism is 99.5%, with mortality rates of 0–2% and complication rates of 8–18%.[8,12] Radical nephrectomy and cystectomy have been carried out on selected octogenarians with perioperative mortality of less than 10%.[13]

Major orthopaedic surgery, including hip and knee arthroplasty, can be carried out in the over-80s with little or no mortality, and significant pain relief and functional improvement.[14] Of octogenarians receiving hip replacements, 70% are able to walk unaided.[15] While most of these case series have selected patients based on premorbid state and concurrent illness, co-morbidities have remained common and, therefore, these studies are applicable to many of our patients.

Head and neck cancers, mainly squamous carcinomas (SCCs), can be treated effectively in older people. In a case control study with 1882 pairs, Bhattacharyya demonstrated that there is no clinically significant difference in disease specific survival from SCC between patients over and under 70 years of age.[16] A cohort study of patients undergoing major head and neck surgery, including neck dissection, laryngectomy, maxillectomy and reconstructive surgery, demonstrated that co-morbidities increased the risk of complications whereas age did not.[17]

Lumbar stenosis is another age-related disease which can be treated surgically in the over-75s, with approximately 80% experiencing complete or partial relief of back or leg pain, which is similar to data from younger patients. In this study, 18% suffered a systemic complication (mainly cardiovascular), and 14% had wound complications.[18]

In neurosurgery, 'elderly' usually refers to people over 65. Meningiomas are usually benign but may become symptomatic and even life threatening due to mass effect. Surgery can be curative, and can be as effective in healthy people over 65 (American Society of Anesthesiologists [ASA] grade 1 or 2) as in younger subjects, with similar complication and mortality rates. Patients who undergo surgery show an overall improved performance status, whereas those treated conservatively will generally deteriorate.[19] Surgery for malignant brain tumours, including glioblastomas and metastases, seems to confer a survival benefit, but quality of life data are lacking.[19] In a retrospective study of 39 patients over 70, Ferrante *et al.* showed that trans-sphenoidal surgery for pituitary adenomas improved vision in 75% of cases,

with no mortality and complications in only 20%. However, relatively few showed resolution of their hypopituitary state when compared to younger patients.[20]

Emergency surgery

Unlike elective operations, emergency surgery in elderly people carries disproportionately high risk, as patients tend to present later, are often harder to diagnose and have poorer functional reserve. Appendicitis in people more than 60 years old, for example, carries more than double the mortality and complication risk when compared to younger patients, attributable to an initial lack of fever, leukocytosis and localizing signs, and earlier perforation.[8,12] Coronary artery bypass grafting in octogenarians carries a mortality of 33% for emergency surgery and 14% for urgent surgery compared with 3% for elective surgery. [5]

Much of the emergency surgery performed on elderly people is for injuries due to trauma, such as femoral neck fractures. Falls are common in older people due to visual, locomotor and balance impairment. Injuries are sustained more commonly than in younger people and are more severe, with greater long-term morbidity. The fracture rate from a fall on level ground may be as high as 40%. Of those admitted to hospital following a fall, 43% are discharged to a nursing home and 1-year survival is a dismal 50%.[8]

Head injuries sustained by older people tend to be *less* severe than those in younger people, possibly because of lower energy trauma such as falls from standing. Despite this, the mortality in the over-65s is higher, functional outcomes are worse, and they are more likely to need long-term care.[21] Older people with head injuries are investigated less promptly and transferred to neurosurgical units less frequently than younger patients. It is unclear how much this contributes to the poorer outcome.[22] Chronic subdural haematoma is exceptional, as burr-hole drainage can be performed under local anaesthetic on all but the sickest patient and outcomes are generally good.[19]

Modern techniques may permit a minimally invasive emergency procedure to be performed to stabilize elderly people, thus affording the opportunity for full resuscitation and optimization before definitive surgery. For example, emergency percutaneous drainage of a gallbladder empyema or endoscopic sphincterotomy for obstructive jaundice can obviate the need for major emergency surgery, prior to a planned cholecystectomy.[8]

Decision making in emergency scenarios is often difficult, particularly with older people. This is due to incomplete information about co-morbidities, and the need to help patients and their families make major decisions in a timely manner. Investigation, optimization and discussion can all add delays to surgery in older people presenting as emergency cases.[23]

Risks and benefits

In elderly patients, as with any other age group, life with quality is of paramount importance. The surgeon must aim to relieve suffering and maintain independence and dignity. Surgeons should not forget that extended life may bring happiness, nor assume that it will. For some patients, the relatively higher risks of surgery may still be small compared to the hazards of not operating, and early aggressive surgery may be the better option. For example, the incidence of abdominal aortic aneurysm (AAA) peaks in the ninth decade. Untreated, the outlook is poor: 35% will rupture at a median 18 months. In octogenarians, 30-day mortality for *elective* repair is 8%, with 83–90% 3-year survival, making a selected aggressive approach beneficial even in the over-80s.[24,25] Endovascular stenting of AAAs may increase the proportion of the elderly population who are treatable, as mortality in the over-80s is similar to that of open surgery, despite almost a third of the study participants being unfit for open repair.[26] In other situations, such as disseminated malignancy, extreme measures may be inappropriate and palliative care may be preferable.[23]

Analysis of complications and deaths demonstrates that age makes only a minor contribution to the risk of surgery, and that postoperative morbidity reflects preoperative health status. Advanced age is a risk factor for poor outcome in both the APACHE (Acute Physiology And Chronic Health Evaluation) and POSSUM (Physiological and Operative Severity Score for the enUmeration of Mortality and Morbidity) systems and their modifications.[27,28] However, age over 80 counts for only 20 of a maximum 139 points on the Parsonnet risk stratification for cardiac surgery, and does not feature on the Revised Cardiac Risk Index, which assesses the risk of perioperative cardiac morbidity and mortality in patients undergoing non-cardiac surgery (Table 1).[8,29–31] ASA grading makes no judgement on age yet remains useful in elderly people.[32] Of far greater importance than age are co-morbidities that accumulate over the years and acute physiological derangement.

Table 1
Revised Cardiac Risk Index criteria to predict cardiac risk from non-cardiac surgery.[31] One criterion gives a cardiac risk of 2%, and the risk for three or more criteria is 9%

RCRI criterion	*Definition*
High-risk surgical procedure	Supra-inguinal vascular, thoracic or abdominal surgery
Ischaemic heart disease	History of myocardial infarction
	History of or current angina
	Use of sublingual glyceryl trinitrate
	Positive exercise test
	Pathological Q waves on ECG
	Patients who have undergone PTCA or CABG and who have chest pain presumed to be of ischaemic origin
Heart failure	Left ventricular failure by physical examination
	History of paroxysmal nocturnal dyspnoea
	S3 or bilateral coarse crackles on physical examination
	Pulmonary oedema on chest x-ray
Cerebrovascular disease	History of transient ischaemic attack
	History of stroke
Diabetes mellitus	Diabetes mellitus treated with insulin preoperatively.
Chronic renal impairment	Baseline creatinine >177μmol/L (>2.0mg/dL)

Elderly people are not just older adults

Physiology differs at both ends of the spectrum, and the mantra 'children are just not small adults' is well recognized. Similarly, age related changes in organs underpin the loss of functional reserve, which may only become apparent under the stress of anaesthesia and surgery (Table 2). For example, reliance on cardiac filling to increase end diastolic volume makes cardiac output vulnerable to hypovolaemia and postoperative atrial fibrillation. Similarly, intra-abdominal and intra-thoracic procedures invariably impair respiratory mechanics. In the elderly, this effect may be sufficient to provoke respiratory failure.[8,11,30–33]

Is my patient fit for surgery?

Careful assessment of elderly patients is necessary before undertaking surgery, taking into account the index illness, co-morbidities, the effects of ageing, and residual impairments from past diseases.[32] Routine tests may not detect loss of reserve, so assessments of function are often preferable, such as exercise tolerance or determination of anaerobic threshold. Synchronous loss of renal function and lean body mass means that serum creatinine levels may remain normal in the face of significant renal impairment, so creatinine clearance should be measured or estimated glomerular filtration rate used for an accurate assessment. Clinical and laboratory data can be incorporated into a risk assessment tool, such as those mentioned above, and be used to optimize patients prior to elective surgery.[8,30,32]

Malnutrition, the subject of the Age Concern 'Hungry to be Heard' campaign, affects 40% of those aged over 65 who are admitted to hospital.[35,36] Loss of appetite may be due to impaired smell, taste and vision, social isolation, poor dentition, poverty, depression, dementia, medication and ill health.[35] Malnourished patients have higher mortality, more falls, longer hospital stays and more postoperative complications (e.g. infections and pressure sores) than their well-nourished peers. Used alone, body mass index is a poor tool in the elderly, as it cannot accommodate height loss, oedema or ascites, so screening tools such as the Malnutrition Universal Screening Tool (MUST) are frequently employed. Blood markers of malnutrition include low albumin, transferrin, lymphocytes and total cholesterol.[35] While many authors write in favour of addressing malnutrition prior to elective surgery, evidence to support or refute this point of view is lacking, as studies have mainly looked at nutritional markers – such as weight gain – rather than patient outcomes.[11,12,30,35]

How can the risks of surgery be reduced?

Close attention to handling, temperature and fluid management can reduce the risks of surgery in older people. During the operation, careful handling is necessary to avoid musculoskeletal injury, exacerbation of arthritis and pressure area damage.[34] If body temperature is allowed to drop,

Table 2
Age related changes in human physiology. [8,11,30,32,33]

System	*Age related changes*	*Effect*
Cardiovascular	Heart and vessels stiffen	Diastolic dysfunction
	Left ventricular hypertrophy	Cardiac output ↓ by 1% per year from age 30
	Loss of responsiveness to catecholamines	Cardiac output ↑ by enlarging end diastolic volume
		Blunted tachycardia response
Respiratory	Loss of elasticity	Loss of 50% 'breathing capacity' by age 70
	Muscle atrophy	↓ resting pO_2
	Increased chest wall stiffness	Closing volume* ↑ towards maximal chest expansion, particularly in supine position
	Impaired gas exchange	
	Reduced response to hypercapnia and hypoxia	
Renal	Reduced renal blood flow	↓ glomerular filtration rate by 1ml min^{-1} per year
	Lower glomerular filtration rate	Impaired salt and water homeostasis makes fluid management difficult
	Impaired tubular function	↑ sensitivity to pharmacological insults
	Asymptomatic urinary tract infection	Drugs and metabolites accumulate
		Risk of endoprosthesis infection
Locomotor	Reduced muscle bulk	Risk of fractures, dislocation and exacerbation of arthritis when moving anaesthetized patient
	Osteoporosis	
	Ligament laxity	
	Arthritis	
Immune	Solid organ atrophy	Blunted response to infection (lack of fever and leukocytosis)
	↓ T, B-cell and macrophage function	
Liver	Impaired oxidative function with normal glucuronidation	↓ metabolism of some drugs
Gastrointestinal	↓ gut motility	Gastro-oesophageal reflux
		Constipation
Neurological	Reduction in neuronal size and connectivity	Grey and white matter loss
	Neuronal loss, including spine and autonomic nervous system	Impaired processing of information
		Cognitive impairment
		Reduced homeostatic autonomic responses
Sensory	Presbyacusis	Deafness 35%
	Presbyopia	Blindness 30%
	Cataract	Impaired balance
	Reduced sensory acuity	Pressure sores
Skin	Atrophy, loss of collagen	Bruising
		Tears, especially with adhesive dressings
		Pressure sores

* Thoracic volume at which small airways close

elderly people are prone to deeper, more prolonged hypothermia than younger patients. Maintaining normothermia cuts cardiac morbidity by 55%.[30] The National Confidential Enquiry into Patient Outcome and Death (NCEPOD) report *Extremes of Age* found that fluid management in elderly people is often poor, and careful attention must be paid to fluid and electrolytes, with an understanding of the age-related changes to the kidney and cardiovascular system.[23] A growing body of evidence favours using some measure of cardiac output, such as that provided by oesophageal Doppler ultrasonography or lithium dilution (LiDCO), to guide intraoperative fluid filling. For example, a randomized controlled trial of patients over 69 with proximal femoral fractures demonstrated a reduction in hospital stay from 20 to 12 days by using intraoperative oesophageal Doppler ultrasound to guide fluid management.[37]

Postoperative cognitive dysfunction

Postoperative cognitive dysfunction (POCD) is a problem peculiar to geriatric patients. While preoperative cognitive impairment, blood loss, sleep deprivation, infection and electrolyte disturbances (especially hyponatraemia) are some of the risk factors for early POCD, multivariate analysis identifies age alone as a risk factor for long term sequelae. Cardiac surgery is particularly disorientating, but all surgery carries a risk, with incidences of POCD quoted from 5–61% depending on patient group and operation. Confusion usually starts after an initial lucid postoperative interval, and isolation in dim rooms is particularly hazardous.[11,30,33]

Management is aimed at reorientation, reassurance and reversing precipitating causes. Infection and myocardial infarction may present with cognitive dysfunction, so should be actively investigated. Pain may be a precipitant, so analgesia should not be withheld. Alcohol and drug withdrawal must not be forgotten in the differential diagnosis. A well-lit quiet room with visitors, hearing and visual aids and personal effects may aid recovery. While some patients are 'never the same again' after surgery, more than 90% of those experiencing POCD recover, although this may take weeks or even months in some cases.[11,30]

Conclusion

Neither a referring physician nor an assessing surgeon should deny patients surgery purely on the basis of age. Instead, decisions should be based on medical need, ability to benefit, overall health status and the wishes of the patient.[2] Where surgeons have looked beyond age to recognize the importance of co-morbidities and physiological derangement, they have repeatedly demonstrated that selected patients can have good outcomes. Even high-risk patients may find elective surgery, for colorectal cancer for example, preferable to emergency treatment for complications such as bowel obstruction. NCEPOD's report *Extremes of Age* recommends that the expertise of both surgeon and anaesthetist be 'matched to the physical status of the patient, as well as to the technical demands of the procedure'. Moreover, a decision to operate necessitates a commitment to provide adequate postoperative care, including high dependency or intensive care if indicated.[23] It would be wise to discuss the wishes of the patient in the event of a catastrophe, and ensure that the family are aware of their relative's wishes.

Much of the evidence still comes from case series, so robust prospective trials are necessary in elderly people to assess the benefits and risks of surgery, including measures of both quality and quantity of life gained.

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